When you create a mine there are two things you can't avoid:
a hole in the ground and a dump for waste rock.
Charles Park, quoted in *Encounters with the Archdruid*, 1971

ENDOCRINE DISRUPTORS

PCBs' Legacy: Fewer Boys

The world's worst polychlorinated biphenyl (PCB) contamination incident plagues male victims two decades later in their weakened ability to father boys. In 1979, 2,000 people in Yu-Cheng, Taiwan, were exposed to PCBs from contaminated cooking oil. Only 46% of children born to young men exposed in this oil disaster are male (compared to a world average of 51–52%), report a team of researchers from London and Taiwan in the 13 July 2002 issue of *The Lancet*. Women exposed in the same incident showed no abnormalities in the sex ratio of their offspring.

PCBs are synthetic organic chemicals used extensively for five decades to insulate electrical equipment. PCBs were used as a heat-transfer medium in processing the rice oil involved in the Yu-Cheng incident. PCBs accidentally leaked from a pipe into the oil, and polychlorinated dibenzofurans (PCDFs) were formed as a by-product during the oil processing as well as later during cooking.

PCBs were banned in the United States more than 25 years ago, but persist in the environment and accumulate in body fat. "Some PCBs are forever," says Walter Rogan, a senior epidemiologist at the NIEHS and a researcher in earlier Yu-Cheng studies. "They don't degrade or metabolize. They're very stable." PCB levels in Yu-Cheng victims remain about 20 times the U.S. average, according to Rogan, and their PCDF levels are 10,000 times the U.S. average.

The researchers don't understand how the chemicals alter sex ratios; they've had few exposed populations to study and are unable to replicate the phenomenon in animal models. But they suspect that PCBs somehow inhibit either sperm carrying the male Y chromosome or the XY-fertilized egg. Only men carry the sex-differentiating chromosome, which could explain why exposed women had children at normal sex ratios.

The researchers analyzed the sex of children born between 1979 and 1999 to 996 exposed mothers and 693 exposed fathers. (In a few couples, both parents had been exposed, but there were too few of these couples to be considered a study group.) For every exposed parent, the team enrolled three same-sex parents of similar age and neighborhood in a control group.

Exposed men of all ages fathered fewer boys than those in the control group. The effect was greatest in men exposed before age 20, who had a male birth rate of 46%. Men of the same generation in the control group had a male birth rate of 54%.

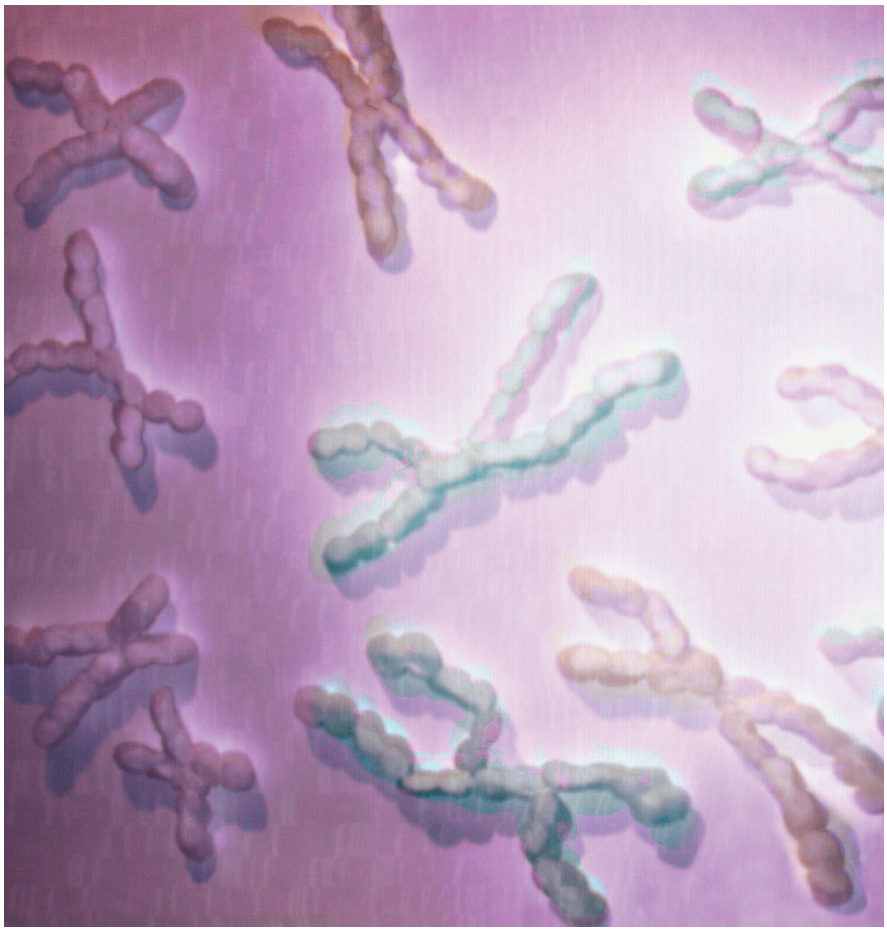
The lower ratio of male offspring in men exposed before age 20 suggests that men are most vulnerable to endocrine disruptors during their sexual development. "We see that developmental processes are at greater risk," says Iliana del Rio Gomez, a researcher from the London School of Hygiene & Tropical Medicine in England and coauthor of the *Lancet* report.

Del Rio Gomez suspects that the altered sex ratio of offspring is just one of a cluster of endocrine-disrupting effects that PCBs have on males. "When a population shows evidence of one [pathology], it is suggested that researchers should try to identify others, as they are more likely to be present, too," she says. "Sex ratios are being seen as a useful indicator of reproductive hazards in men and women."

Del Rio Gomez and her colleagues are studying fertility in Yu-Cheng men and women, and expect to publish their findings in the future.

In the January 2002 issue of the *Journal of Occupational and Environmental Medicine*, a team led by epidemiologist Wilfried Karmaus of Michigan State University reported skewed sex ratios in the children of Michigan men who ate PCB-contaminated fish from the Great Lakes. In this case, however, the men fathered fewer girls. "We don't know why [these PCBs had] the opposite effect," Rogan says.

A mass PCB poisoning on the magnitude of Yu-Cheng is unlikely in the United States. However, scientists warn that, although the contaminants have been banned for years, they remain in old transformers, appliances, and the food chain. Workers cleaning waste sites and people eating fish from contaminated lakes still face a risk. In 2001, eight states issued advisories against eating fish from PCB-contaminated waters. **–Cynthia Washam**



Y are there fewer boys in Yu-Cheng? Decades after the world's worst PCB contamination event, endocrine disruptors seem to blame for births of fewer boys than average.

EyeWire

Metal Toxicity

Aluminum Floc Formation

When aluminum-rich acidic runoff from mining sites travels through less acidic stream or river water, fluffy flocs of suspended solids form. These flocs carry toxic metals—which normally would have stayed in the streambed—downstream from the mine area, where they can poison aquatic animals and plants. Now scientists have gained further insight into how flocs form.

Gerhard Furrer, a geochemist at the Institute of Terrestrial Ecology in Zürich, and colleagues report in the 27 September 2002 issue of *Science* that aluminum flocs originate mainly from condensations of the aluminum complex $AlO_4Al_{12}(OH)_{24}(H_2O)_{12}^{7+}$, or Al_{13}. These condensations form rapidly and then aggregate as the pH of acidic effluent increases to more than 5. Aluminum-rich acidic solutions form Al_{13} as an intermediate compound, then Al_{13} molecules aggregate to form flocs, says coauthor William Casey, a geochemist at the University of California, Davis.

"Previously it was thought that [Al_{13}] was quite rare and kind of a curiosity that you find in some solutions," says Casey. "We now think that it is very, very common—that is the real important finding of this paper," he says.

Paul Bertsch, director of the Savannah River Ecology Laboratory in Aiken, South Carolina, and colleagues had proposed in a chapter of the 1996 text *The Environmental Chemistry of Aluminum* that Al_{13} was a common precursor to aluminum solids and that, based on extensive laboratory studies, it could form under a wide range of environmental conditions. The new paper by Furrer and colleagues provides strong support for this hypothesis, Bertsch says.

The international team analyzed flocs from nine polluted streams in Germany and California using a type of nuclear magnetic resonance spectroscopy called ^{27}Al magic-angle spinning, which detects different types of aluminum complexes in solids. They picked up the signal generated by substantial amounts of so-called 4-coordinated aluminum—aluminum bonded to four oxygen atoms. Only dissolved Al_{13} has that type of aluminum in large concentrations at the pH conditions found in the polluted rivers, says Casey. This suggested that Al_{13} was the key aluminum molecule acting in floc.

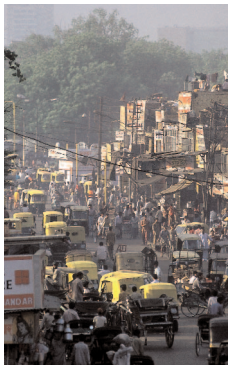
About 240,000 square kilometers of the Earth's surface are affected by mining operations, say the authors. With such a large area involved, many watersheds are polluted with acidity, aluminum, and other potentially toxic metals. By identifying Al_{13}—a molecule that is known to be phytotoxic and to have a high affinity for heavy metal cations—as the key molecule in floc formation, researchers now might be able to develop new approaches to attack this weighty pollution problem. **–Tina Adler**

Toxic transporter. Aluminum from acid mine drainage helps to carry other toxicants downstream where they can poison animals and plants.

Clockwise from left: Gerhard Furrer; Panos Pictures; Arnold Greenwell/EHP

New Subway for New Delhi

In December 2002 India's second subway system opened for service in New Delhi, one of the world's most traffic-congested cities, with 4 million vehicles. The city's aging bus system has been struggling to meet commuter demand, causing many people to turn to taxis, rickshaws, and private vehicles and further compounding the street overcrowding and pollution problems. Almost 70% of the city's air pollution is caused by vehicles; although regulations require public transportation providers to use less-polluting fuels such as compressed natural gas, transport unions have defied the laws. Only a 5-mile stretch of the line is currently operational, but the entire 155-mile network is slated for completion by 2021, when officials hope it will reduce the city's air pollution by half.



Solvent-Breathing Bacteria

A bacterium that "breathes" the industrial solvent 1,1,1-trichloroethane (TCA) has been discovered in the Hudson River in New York, report Michigan State University microbiologists. The TCA1 bacterium thrives in the presence of TCA, and it metabolizes the pollutant into chloroethane, which is relatively easily remediated by aerobic soil microbes. An extra benefit is that TCA1 does its cleanup work underwater, which keeps TCA from escaping into the atmosphere, where it can cause ozone depletion. Until the United States banned TCA in 1996, it was used in glues, paints, industrial degreasers, and aerosol sprays. Today it is present in half of all Superfund sites.

Mercury Labels for Lightbulbs

Fluorescent lightbulb manufacturers have announced a nationwide program for labeling the estimated 600 million mercury-containing fluorescent and high-intensity discharge bulbs sold in the United States annually. Eight manufacturers and their trade group, the National Electrical Manufacturers Association, decided to implement the new program this year after losing an appeal to overturn a state mercury labeling law passed in 1998 by Vermont. This state law also requires manufacturers to provide $20,000 to educate Vermont consumers about the hazards of breaking and improperly disposing of mercury-containing bulbs.

As part of the national program, mercury-containing bulbs produced by these makers will display the symbol "Hg." Packaging will also include the symbol as well as a URL (**http://www.lamprecycle.org/**) and a toll-free telephone number for information on properly disposing of broken or spent bulbs.

HAZARDOUS WASTE

Defense Cleanup: A Quick and Dirty Review

Over 9,000 formerly used defense sites, or FUDS, dot the landscape of the United States and its territories. These sites include storage depots, military bases, radar stations, and missile sites. Although the sites have been retired, the hazards contained on some of them have not—structurally unsound buildings, radioactive and toxic wastes, explosives, and chemical warfare agents all remain, and will cost an estimated $16 billion to clean up, according to U.S. Army Corps of Engineers spokeswoman Candice Walters. The corps is responsible for determining whether the Department of Defense (DOD) caused the contamination on such sites and for cleaning up military-related contamination. Sites that are determined to not have been contaminated by the DOD are classified as "no DOD action indicated," or NDAI. But according to the August 2002 General Accounting Office (GAO) report *Environmental Contamination: The Corps Needs to Reassess Its Determinations That Many Formerly Used Defense Sites Do Not Need Cleanup*, nearly 40% of the corps' decisions on DOD responsibility are "questionable."

The report was requested by John Dingell (D–Michigan) of the House Committee on Energy and Commerce, who has long expressed concern about pollution and the military. The GAO reviewed a random sample of 603 records of corps examinations and estimated, based on the evidence in the files, that the corps was not justified in determining that 1,468 of a total of 3,840 sites do not require DOD action. In one example cited in the report, maps of a former military airfield indicated the presence of a building for storing bombs, but there was no indication that the corps searched for this building and the possible hazards posed by leftover munitions. "[T]here is no evidence that the Corps reviewed or obtained information that would allow it to identify all the potential hazards at the [questionable] sites or that it took sufficient steps to assess the presence of potential hazards," the report concludes.

"Many of the FUDS properties are [now] owned by private individuals. These are now homes, schools, parks where people are going. You don't know what level of risk exists in those areas," says Sherry McDonald, a senior GAO analyst who worked on the report.

The corps maintains it has a limited mandate in dealing with environmental problems at FUDS. "'NDAI' does not mean that there may not be some contamination there," says Walters—only that the DOD is not responsible for cleaning it up. If the contamination is not the fault of the DOD, "it is up to the states [where the facility is] or the U.S. Environmental Protection Agency to determine who's responsible for cleaning it up," she says.

One reason for the inconsistent determinations may have been the vague guidelines under which the corps operated. For example, corps guidelines originally failed to indicate what site-related documents should be examined and how detailed such examination should be. In a letter attached to the report, deputy undersecretary of defense Raymond Dubois states that many of the files examined were from the early days of the cleanup program and that the examinations are now more detailed. However, Edward Zadjura, assistant director of the GAO's Natural Resource and Environment Team, stoutly defends the study's methods, saying that the files examined were randomly chosen and that there was no statistical bias. He emphasizes that the files on the problem sites are simply inadequate to back the NDAI rating.

The GAO report recommends that the corps review its conclusions regarding the NDAI status of certain sites. Walters says the corps is doing that, working with states to reassess between four and six sites per state annually. And in line with report recommendations, the corps is revising its assessment procedures, says Walters, and has developed a new checklist that must be completed before a cleanup determination is made. Among the questions to be answered are whether prior studies of the sites were examined and whether site maps, aerial or ground photographs, or real estate records were reviewed. Such documents would describe the transfer of sites—including information on other potential polluters—and provide leads on where inspectors might look to find pollution. **–Harvey Black**

DOD

CHILDREN'S HEALTH

Low Birth Weight Linked to Asthma

Health experts know that asthma occurs more often in black children than in children of other races, but cannot fully explain why. In searching for clues, they have implicated environmental and socioeconomic factors such as exposure to cockroach allergens, poor indoor and outdoor air quality, and living in impoverished inner-city locations. A report published in the May 2002 issue of the *Annals of Allergy, Asthma & Immunology* suggests that low birth weight also plays a role. According to the investigators, black infants born at weights less than 2,500 grams are significantly more likely than other babies to develop asthma.

Christine Joseph, an epidemiologist at the Henry Ford Health System in Detroit, Michigan, began by sorting out the relationship between two common observations. First, black children are 2–3 times more likely to be afflicted with asthma compared with children of other races. Second, black women are 2–3 times more likely than other women to deliver low birth weight babies.

To determine whether asthma and low birth weight are connected, Joseph and her colleagues surveyed 126 children aged 6–8 years and their parents in Southfield, Michigan, a middle-class suburb of Detroit. Seventy percent of the children were black, and 30% were white. About half the residents of Southfield are black, and they earn slightly more than their nonblack neighbors. Therefore, any differences in asthma occurrence observed between black and nonblack children would more likely be due to race than to socioeconomic status.

Pediatric allergists tested the children for asthma, using appropriate tests of lung function. Parents provided birth records or recalled their children's birth weights. Overall, 13 children were diagnosed with asthma, giving a prevalence of 10.3%. Black children reported asthma 2.3 times more often than white children, and were 4.2 times more likely to have had low birth weights. Moreover, the black children with low birth weights were 5 times more likely than other children with low birth weight to develop asthma. After considering factors that contribute to asthma, statistical analysis

The Beat

ehpnet Acid Drainage Technology Initiative Metal Mining Sector

The Acid Drainage Technology Initiative (ADTI) was begun in 1995 by the National Mining Association, the Interstate Mining Compact Commission, and federal agencies including the Bureau of Land Management and the U.S. Environmental Protection Agency to address AMD in the United States. Its work is performed in two sectors, coal mining and metal mining. The ADTI's Metal Mining Sector (MMS) has developed a website, located at http://www.unr.edu/mines/adti/index.html, to disseminate the information gathered through its programs.

The main focuses of the ADTI-MMS are technology development and technology transfer issues in the environmental management of metal mines. The initiative is charged with finding ways to reduce the extent and severity of AMD and its effects, developing consensus on environmental mine waste management technologies, identifying technological needs, and using sound scientific and technological bases to interpret, assess, and summarize published literature and operational practices.

The initial goal of the ADTI-MMS is to develop a series of workbooks for mine managers and planners, consultants, regulators, and others that compile and analyze existing technical information on environmental mine waste management. The workbooks, which should be completed and available on the website in the near future, will cover sampling, monitoring, prediction, mitigation, and modeling.

The Projects page provides overviews of other work that the ADTI-MMS is conducting or planning. The U.S. Army Corps of Engineers is collaborating with the ADTI-MMS to develop a database of metal mining remediation technologies. The ADTI-MMS is also in the process of generating funds for several proposed data compilation projects. One would identify existing data on the effectiveness of mine waste drainage quality prediction and remediation techniques that have been implemented so far. Another would identify literature and sources of information to support a model of metals loading from mining areas to streams and reservoirs, as well as areas of metal deposition. Still another would adapt a coal mining passive treatment flow chart devised by the Bureau of Mines for use in metal mining. The flow chart system as envisioned would allow input of such determinants of AMD as mine site weather and chemical conditions.

A links page including the websites of such organizations as the Sustainable Minerals Roundtable, the International Network for Acid Prevention, and the Mine Environmental Neutral Drainage Program is also provided. **–Erin E. Dooley**

suggested that 31% of the asthma cases were attributable to low birth weight.

"Low birth weight may explain the racial differences we see in asthma in the United States," says Joseph. However, she adds, "We still do not know how to prevent low birth weight." Health experts recognize that certain factors are associated with low birth weight, such as maternal smoking during pregnancy and poor nutrition. As more factors are uncovered, "low birth weight may emerge as a modifiable factor," says Joseph.

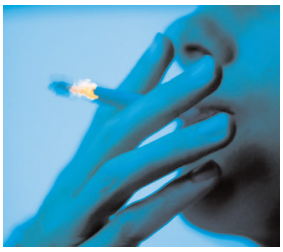
Because of advances in neonatology, infants born today with low birth weights are likely to survive. "Now we know that they may be at risk for asthma," says Dennis Ownby, a pediatrician at the Medical College of Georgia in Augusta and a coauthor of the paper.

The study results spark more questions for future research. For instance, Ownby wonders whether low birth weight babies who go home to inner-city apartments with suboptimal indoor and outdoor air quality are at higher risk for asthma than low birth weight babies who live in the suburbs. "We need more studies to consider these things," Ownby says.

This is the first study known to look at the relationship between low birth weight and asthma. In the words of Cheryl Blackmore Prince, an epidemiologist with the Hawaii Department of Health and an expert on the association between low birth weight and infant mortality, "This is further evidence that we need to do something about the low birth weight problem." **–Carol Potera**

Desperately Seeking Smokers

More than 150,000 people will die of lung cancer this year, and an estimated 90 million current and former U.S. smokers are at high risk for the disease, say National Cancer Institute scientists. To determine if spiral computerized tomography (CT) can help prevent more lung cancer deaths than chest X rays, researchers at 30 U.S. sites launched the National Lung Screening Trial in September 2002. Spiral CT can detect smaller tumors than chest X rays, but it is not known whether this increases a patient's chance of survival. The clinical trial, the largest ever funded by the institute, will enroll 50,000 healthy current and former smokers, who will receive one of the types of screening once a year for three years. The participants' health status will then be monitored until 2009.



A Better Environment for Breast Cancer?

New data from several sources—including the National Cancer Institute, the journal *Breast Cancer Research* (*BCR*), and a report released by The Breast Cancer Fund and Breast Cancer Action—have advocates calling for more studies of the possible link between environmental factors and increased rates of breast cancer. The data from these sources all show increases in cases of breast cancer over the past 15 years, with a May 2002 *BCR* article reporting a 72% jump over the 1990s among women aged 46–64 in Marin County, California. Groups including the National Breast Cancer Coalition argue that, although studies that link environmental toxicants such as benzene to breast cancer have been conducted, not enough federal money is being spent on exploring this connection to its fullest. According to the coalition, only 3% of federal cancer research funding goes toward studying environmental links.

Wiping Out Lead at Work

The CDC's Technology Transfer Office has announced a new patent for a handwipe that can easily and quickly alert workers to lead contamination. The handwipe can test a variety of surfaces, including skin, steering wheels, and furniture. It changes color if lead is detected, warning users to clean their clothing and wash their hands thoroughly to remove all lead residue. According to OSHA, lead overexposure is a leading cause of work-related illness, with oral ingestion of inorganic lead during eating, drinking, and smoking at work a major route of exposure. Welding, removal of lead paint from old buildings, radiator repair, and smelting are among activities with high potential for occupational lead exposure.

Clockwise from left: Bureau of Land Management; PhotoDisc; Joseph Tarf/EHP